SOLID STATE

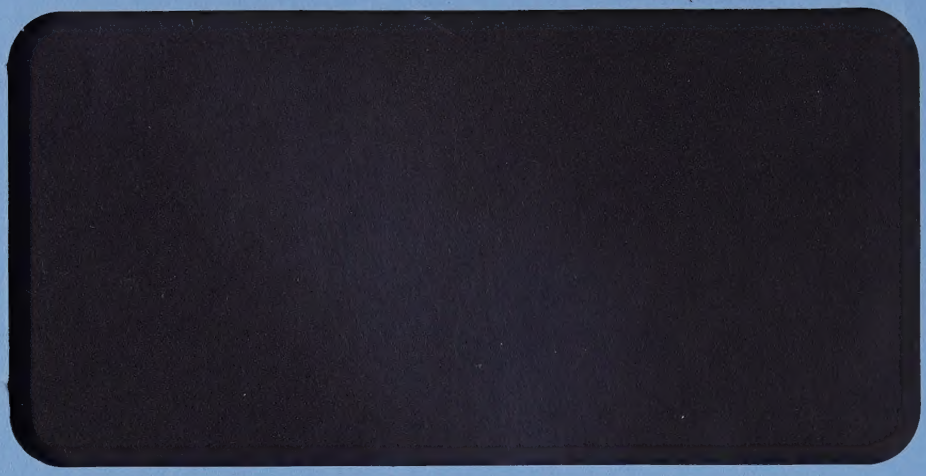
# BAND-PASS FILTER

MODEL 3700 SERIAL NO. 2262

# OPERATING AND MAINTENANCE MANUAL

**KROHN-HITE CORPORATION**

Avon Industrial Park/Bodwell St., Avon Massachusetts 02322 U.S.A.



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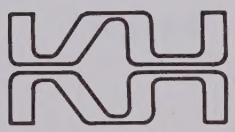

**KROHN-HITE CORPORATION**

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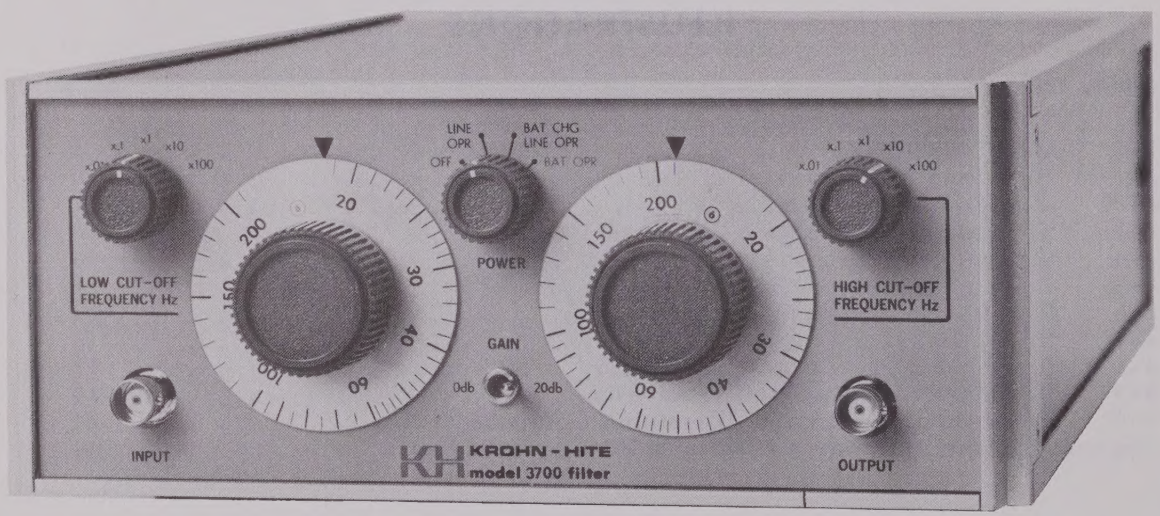



Model 3700

Figure 1-1. Model 3700 Filter

# SECTION 1
# DESCRIPTION

## 1.1 INTRODUCTION

The Krohn-Hite Model 3700 is an all solid state variable electronic band pass filter covering the frequency range of 0.2 Hz to 20 kHz. Upper and lower cutoff frequencies are independently adjustable over the entire tuning range with an attenuation rate of 24dB per octave outside the passband.

An optional rack-mounting kit (Part No. RK-38) is available for installing the 3700 in a standard, 19" rack spacing. An optional battery kit (Part No. BK-370) is also available.

## 1.2 GENERAL SPECIFICATIONS

### Function

Band-pass

### Frequency Range

Low-cutoff and high-cutoff frequencies are independently adjustable from 0.2 Hz to 20 kHz in five bands.

| BAND | MULTIPLIER | FREQUENCY (Hz) |
|---|---|---|
| 1 | 0.01 | 0.2 - 2.0 |
| 2 | 0.1 | 2.0 - 20 |
| 3 | 1 | 20 - 200 |
| 4 | 10 | 200 - 2,000 |
| 5 | 100 | 2,000 - 20,000 |

### Frequency Dials

Separate low-cutoff and high-cutoff dials are calibrated with single logarithmic scales reading directly in Hz from 19 to 210. Total effective scale length for all five bands is approximately 30 inches.

### Cutoff Frequency Calibration Accuracy

±5% with RESPONSE switch in MAX-FLAT (Butterworth) position; less accurate in LOW Q position. Relative to mid-band level, the filter output is down 3 db at cutoff in MAX-FLAT position, and approximately 12 db in LOW Q position.

**Bandwidth**

Continuously variable within the cutoff frequency limits of 0.2 Hz and 20 kHz. For minimum pass-band (Butterworth response) the two cutoffs are set to the same frequency, resulting in an insertion loss of 6 db at that frequency, with 3 db points at factors of .8 below it and 1.25 above it.

**Attenuation Slope**

Nominal 24 db per octave.

**Maximum Attenuation**

Greater than 80 db.

**Pass-Band Gain (Selected by Front Panel Control)**

0 ± 1 db or 20 ± 1 db.

**Response Characteristics**

Choice of 4 pole Butterworth (maximally flat response) for frequency domain operation and Low Q (damped response) for transient-free time domain operation, selected by means of a switch on rear of chassis.

**Input Characteristics**

Maximum Voltage: ±7 volts peak in the 0 db gain position, ±0.7 volts peak in the 20 db gain position.

Maximum DC Component: ±100V.

Input Impedance: 10M ohms in parallel with 50 pf.

**Output Characteristics**

Maximum Voltage: ±7V peak.

Maximum Current: ±1.5 ma peak.

Internal Impedance: approximately 50 ohms.

**Hum and Noise**

Less than 200 microvolts rms.

**Operating Temperature Range**

$0^{\circ}C$ to $45^{\circ}C$

#### Floating (Ungrounded) Operation

A switch is provided on rear of chassis to disconnect signal ground from chassis.

#### Front Panel Controls

Low Cutoff Frequency: Dial and Multiplier switch.

High Cutoff Frequency: Dial and multiplier switch.

POWER Switch

GAIN Switch

#### Rear Panel Controls

115V/230V LINE switch

RESPONSE Switch

GROUND Switch

DC Level Potentiometer

#### Terminals

Front and rear panels, one BNC connector for INPUT, one for OUTPUT. One rear terminal for chassis grounding.

#### Power Requirements

105-125 or 210-250 volts, single phase. 50-400 Hz, 10 watts. Internal batteries (optional). Battery will operate longer than 10 hours without recharging.

#### Dimensions and Weights

Model 3700: 3-1/2" high, 8-5/8" wide, 13-11/16" deep, 11 lbs/5 kgs net, 17 lbs/8 kgs shipping.

# SECTION 2
# OPERATION

## 2.1 INTRODUCTION

The Model 3700 is adjusted and checked carefully to insure that it meets all specifications. It is then aged and again tested before shipment. After unpacking it is ready to be used.

Unpack the filter carefully and inspect it for damage that may have occurred during shipment. Check the case for damage, and check for loose subassemblies and parts. Check all front panel controls for freedom of operation. A complete acceptance checkout procedure is given in Section 3 of this manual.

## 2.2 POWER

### 2.2.1 Power Requirements

The Model 3700 Filter may be used either with a 105-125 volt, 50-400 Hz line or with a 210-250 volt, 50-400 Hz line. The line voltage can be selected by operation of the LINE switch on the rear panel. All units will be shipped with the LINE switch in the 115 volt position and a fuse bag attached to the line cord. The fuse bag will contain a 1/16 ampere fuse. When 230 volt operation is required, replace the 1/8 ampere fuse with the 1/16 ampere fuse and switch the LINE switch to the 230 volt position.

### 2.2.2 Battery Operation

Internal batteries, supplied as an option (Part No. BK-370) will operate for 10 hours without recharging. (See paragraph 2.6 for instructions for installation of the battery kit.) After 10 hours of battery operation, the filter should be operated with the POWER switch in the LINE OPR BAT CHG position for 8 to 12 hours. Longer charging will not damage the batteries; they will age about as much as if in normal use for the same length of time.

## 2.3 CONTROLS AND TERMINALS (FIGURE 2-2)

### 2.3.1 Front Panel

115V/230V LINE switch - sets the Filter AC input for the correct operating mode.

POWER switch - provides for selection of line or battery operation, or for charging the battery during line operation.

LOW-CUTOFF FREQUENCY and HIGH CUT-OFF FREQUENCY dials and band switches - calibrated in Hz, used to select high and low cut-off frequencies.

GAIN switch - for selection of unity (0 dB) or 10x (20 dB) gain.

INPUT and OUTPUT terminals.

### 2.3.2 Rear Panel

RESPONSE switch - used to select a Butterworth (MAX FLAT) or LOW Q response.

GROUND switch - connects (CHAS) or removes (FLTG) signal ground from chassis ground.

DC LEVEL potentiometer - for adjustment of d-c level of output signal.

INPUT and OUTPUT terminals - in parallel with front-panel terminals. (Input terminals, front and rear, have separate 22K HF suppression resistors).

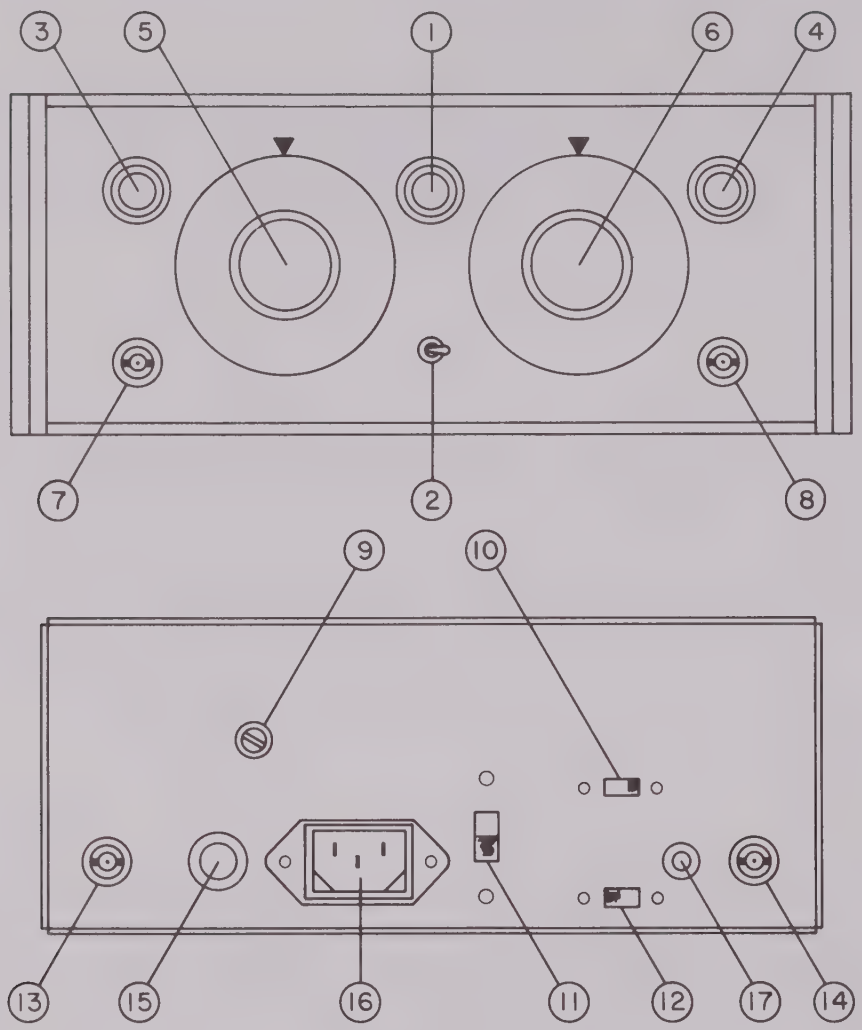
FUSE holder - 1/8 Ampere slo-blo for 117-volt operation, 1/16 Ampere for 234-volt operation.

GROUND terminal - for connecting chassis to system ground.

## 2.4 OPERATION

To operate the filter proceed as follows:

**2.4.1** Make appropriate power connections. (See 2.2). If the unit is equipped with internal batteries, line power is not necessary.




(1) POWER SWITCH
(2) GAIN SWITCH
(3) MULTIPLIER SWITCH (HIGH PASS)
(4) MULTIPLIER SWITCH (LOW PASS)
(5) FREQUENCY DIAL (LOW CUTOFF)
(6) FREQUENCY DIAL (HIGH CUTOFF)
(7) FRONT INPUT (BNC)
(8) FRONT OUTPUT (BNC)
(9) OUTPUT DC LEVEL ADJ.
(10) RESPONSE SWITCH (MAX FLAT/LOW Q)
(11) 115V/230V LINE SWITCH
(12) GROUND SWITCH (FLOATING/CHASSIS)
(13) REAR OUTPUT (BNC)
(14) REAR INPUT (BNC)
(15) FUSE
(16) AC RECEPTACLE
(17) CHASSIS GROUND CONN. (BINDING POST)

Figure 2-1. Front and Rear Panels

**2.4.2** Make the appropriate connections to INPUT and OUTPUT terminals of the filter.

**2.4.3** Set cut-off frequencies by means of the band multiplier switches and the frequency dials. The minimum pass band is obtained by setting the high cut-off frequency equal to the low cutoff frequency.

**2.4.4** Select desired pass-band gain - 0 dB or 20 dB.

**2.4.5** Turn POWER switch to appropriate position.

## 2.5 SPECIAL FUNCTIONS

### 2.5.1 Minimum Bandwidth

The flexibility of adjustment of bandwidth is illustrated in Figure 2-2. Band-pass operation in the MAXimally FLAT or Butterworth mode for two different bandwidths is illustrated by curves A and B. Curve B shows the minimum pass-band width obtained by setting the two cutoff frequencies equal. In this condition the insertion

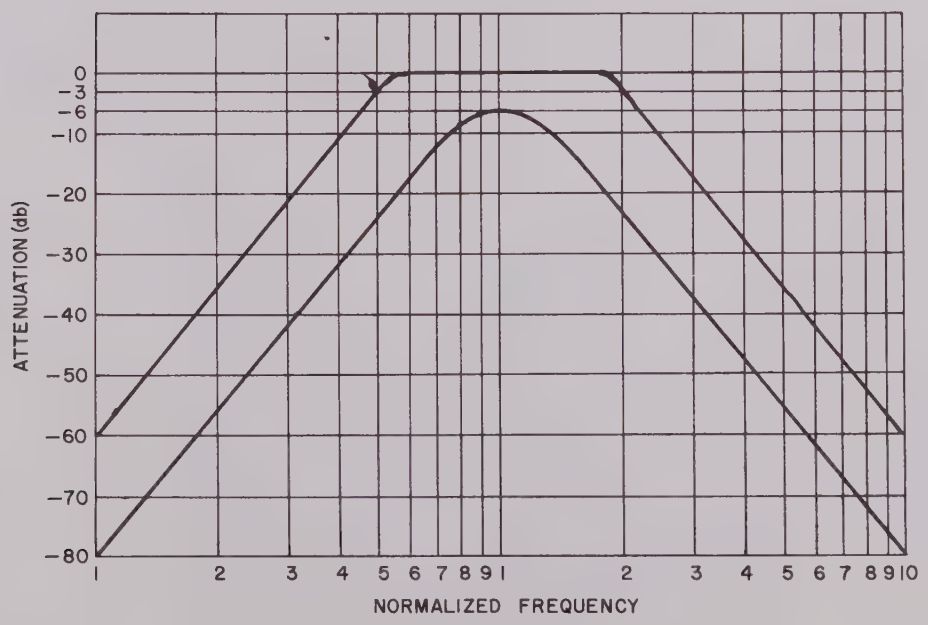



Figure 2-2. Minimum Bandwidth

loss is 6 dB, and the -3 dB cutoff frequencies occur at 0.8 and 1.25 times the mid-band frequency. The minimum pass-band for less than 1% insertion loss is shown by curve A with the cutoffs set at 0.5 and 2 times the mid-band frequency.

### 2.5.2 Cutoff Response

The attenuation characteristics of the Filter are shown in Figure 2-3. With the response switch in the MAXimally FLAT or Butterworth mode, the gain, as shown by the solid curve, is virtually flat until the -3 dB cutoff frequency. At approximately two times the cutoff frequency the attenuation rate coincides with the 24 dB per octave straight line asymptote. In the Low Q mode, optimum for transient-free filtering, the dotted line shows that the gain is down approximately 12 dB at cutoff and reaches 24 dB per octave attenuation rate at five times the cutoff frequency. Beyond this frequency the filter attenuation rate and maximum attenuation, in either mode are identical.

### 2.5.3 Square Wave Response

The frequency response characteristic of this Filter is a fourth order Butterworth function ideal for filtering in the frequency domain. For pulse or transient signal filtering, a response switch is provided to change the frequency response to Low Q, optimum for transient-free filtering. Figure 2-4 shows a comparison of the Filter output response in these modes to a square wave input signal.

### 2.5.4 Phase Response

The phase angle at any frequency is the sum of the angles due to the high-pass and low-pass sections of the Filter. Figure 2-5 gives the phase characteristic for either section in degrees lead (+) or lag (-), as a function of the ratio of the operating frequency f to low cut-off frequency $f_L$ or high cut-off frequency $f_H$.

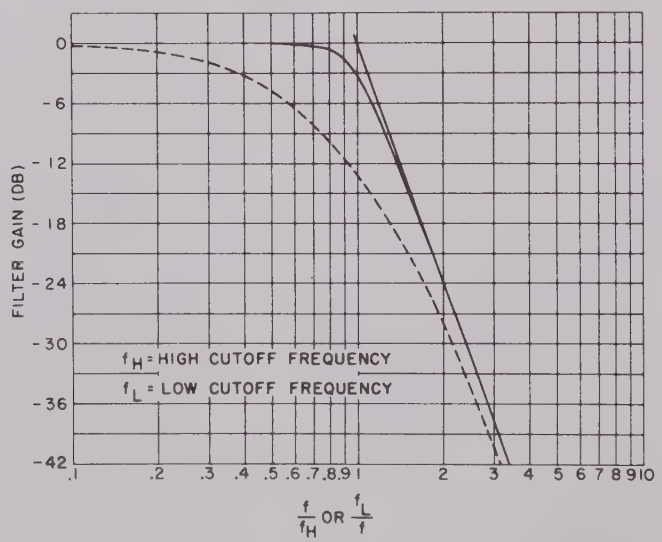



Figure 2-3. Normalized Attenuation Characteristics

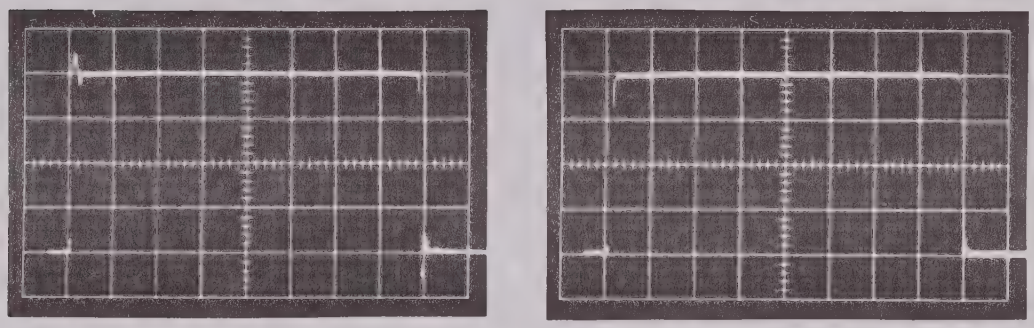


Figure 2-4. Square Wave Response

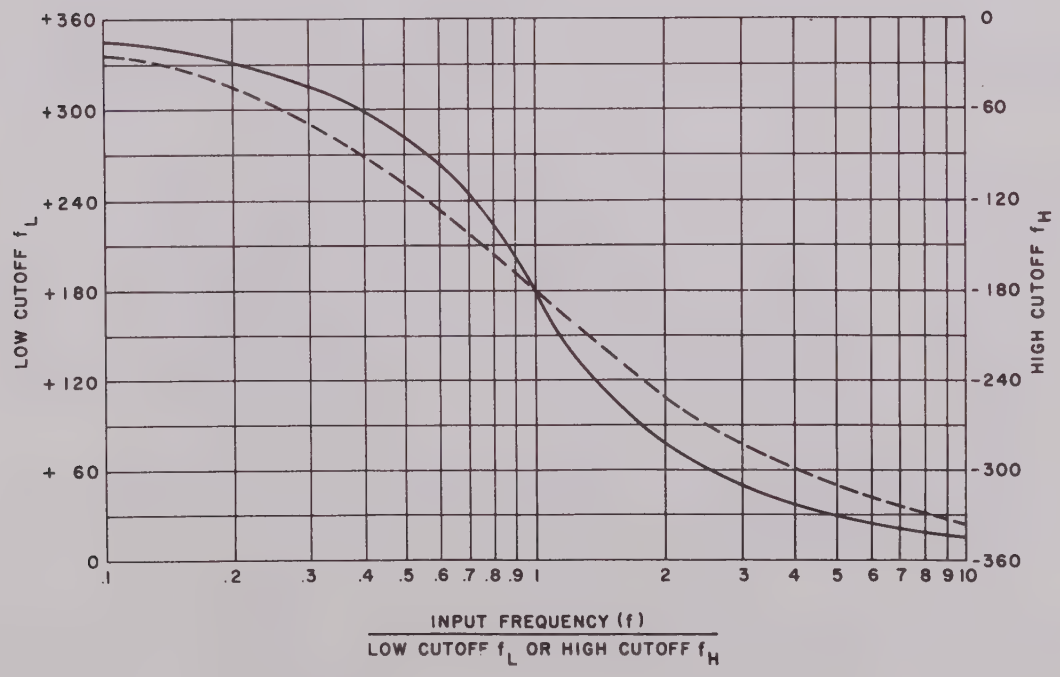



Figure 2-5. Normalized Phase Characteristics

The solid curve is for the maximally flat mode and the dotted curve is for Low Q.

Example:

Determine the phase shift through the filter, in the maximally flat mode with the low cutoff ($f_L$) at 200 $H_z$, and the high cutoff ($f_H$) at 600 Hz and an input frequency (f) at 300 Hz.

Phase shift due to low cut-off ($f_L$)

$$\frac{f}{f_L} = \frac{300}{200} = 1.5$$

from Figure 2-5, phase shift is $110^o$

Phase shift due to high cutoff ($f_H$)

$$\frac{f}{f_H} = \frac{300}{600} = .5$$

from Figure 2-5, phase shift is $-80^o$

Total phase shift = $110^o - 80^o = +30^o$

## 2.6 INSTALLATION OF BATTERY KIT

The Model 3700 is sometimes ordered and shipped without batteries, however, a battery kit may be purchased separately and installed at any time, in accordance with the following procedure.

### 2.6.1 Battery Kit (Part No. BK-370)

| Item | Quantity | Part No. |
|---|---|---|
| Battery | 2 | Y5043 |
| Bracket | 2 | FA2815-B |
| Wafer | 4 | A2830-B |
| Wafer | 2 | A2831-A |
| Disc, Fiberglass | 4 | ----- |
| Liner, Kraft Paper | 2 | ----- |
| Nut, KEP, 6-32 | 12 | ----- |
| Screw, 6-32 x 3/8 PPN | 8 | ----- |
| Screw, 6-32 x 3/8 SEMS | 4 | ----- |
| Tube | 2 | FB2833-2-B |

### 2.6.2 Procedure

There are two battery holders, one for the + 12 volt supply and one for the -12 volt supply. Except for the polarity of the battery connections, the assembly procedure is the same for both. Refer to Figure 2-6.

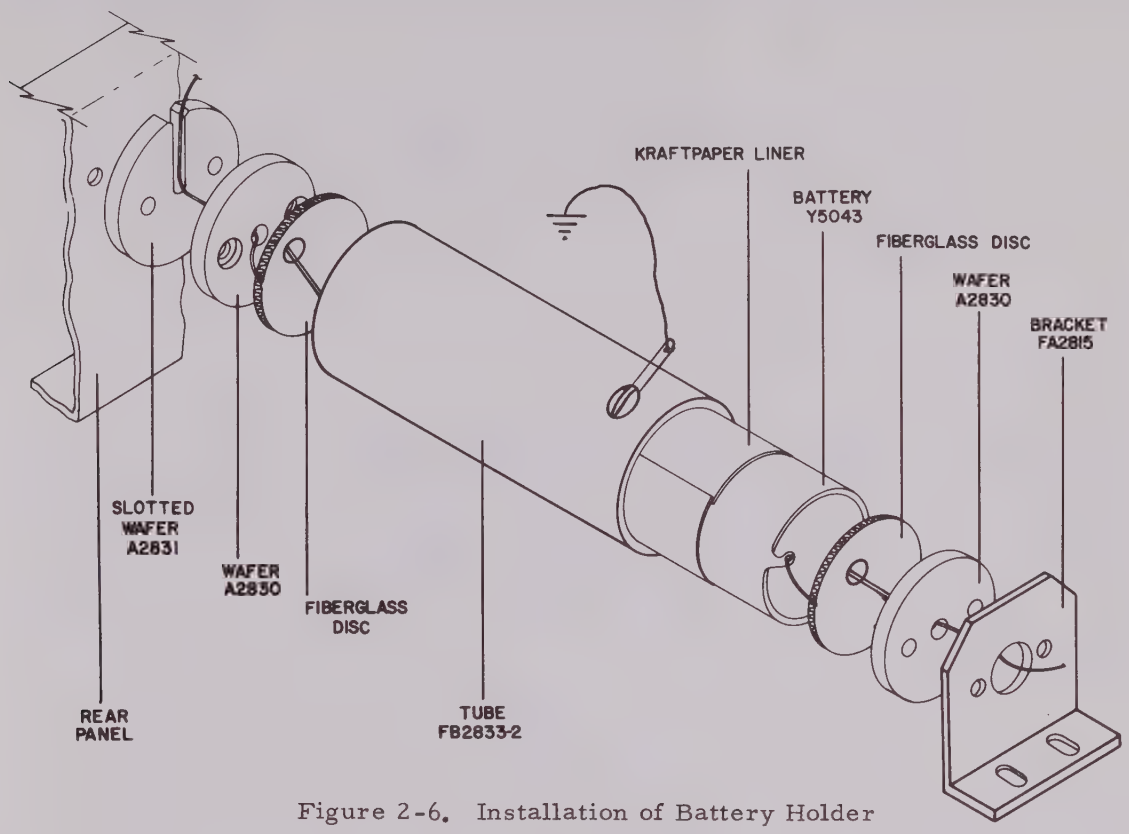



Figure 2-6. Installation of Battery Holder

**2.6.2.1** First solder an 8-inch length of red insulated stranded hookup wire (AWG24) to the positive (+) terminal of each battery, and an 8-inch length of grey insulated wire to the negative terminal of each battery.

**2.6.2.2** Assemble the battery holders in the order shown in Figure 2-6, starting at the inside of the rear panel. The negative lead of the left hand battery and the positive lead of the right hand battery should be toward the rear panel. Thread the wire through the fiberglass disc, through the center holes in the A2830-B wafer, and through the slot in the slotted wafer. The battery lead toward the PC board should be threaded through the fiberglass disc, and through the center holes in the wafer and bracket. After the batteries are in place, trim the wires to about 5 inches.

**2.6.2.3** Connect the positive lead of the left hand battery to one terminal of the PC - pad at the juncture of C501 and C504. Connect the negative lead to terminal 24 on the PC board.

**2.6.2.4** Connect the negative lead of the right hand battery to the remaining unused terminal of the PC pad at the juncture of C501 and C504. Connect the positive lead to terminal 28 on the PC board.

**2.6.2.5** Before using the filter with batteries alone, charge the batteries for 4 hours with the POWER switch in the LINE OPR BAT CHG position.

# SECTION 3
# INCOMING ACCEPTANCE AND INSPECTION

## 3.1 INTRODUCTION

The following procedure should be used to verify the Filter operation within specifications. These checks may be used for incoming inspection and periodic specification checks. Tests must be made with all covers in place. If the instrument is not operating within specifications, refer to Section 5 and 6 before attempting any detailed maintenance. Before testing, follow the initial setup and operating procedures given in Section 2.

## 3.2 TEST EQUIPMENT REQUIRED

The following test equipment is required to perform these tests:

**3.2.1** Digital Voltmeter (DVM), capable of measurements from 1 millivolt to 20 volts, Fluke Model 8000A or equal.

**3.2.2** A-C voltmeter capable of measurements from 100 microvolts to 10 volts rms, Ballantine Model 314A, or equal.

**3.2.3** Oscilloscope DC to 5 MHz, 10 mv/cm sensitivity.

**3.2.4** Oscillator: 0.01 Hz to 100 KHz; with frequency accuracy better than 3%; distortion, hum, noise, less than 0.05%; frequency response ±.05 dB (Krohn-Hite Model 4100A or equal).

## 3.3 TEST PROCEDURE AND CONDITIONS

Table 3-1 gives the conditions and setup for testing the various filter characteristics. Unless otherwise specified in the table, the GAIN switch is in the 0 dB position, and the output load is greater than 1000 ohms. In the table, voltages are rms unless otherwise specified.

NOTE

In making tests at frequencies below 10 Hz, use the oscilloscope instead of the acvm, because the acvm is not accurate at low frequencies. It is suggested that the oscilloscope be set up for a sensitivity of .25 volts/cm, or 1 volt for 20 divisions vertically. The typical -3 dB reading (.63 to .77 volt) would then become 12.6 to 15.8 divisions.

Table 3-1. Acceptance Checkout Procedure

| Test | Low Cutoff | High Cutoff | Input Freq. | Set Amplitude |
|---|---|---|---|---|
| 1. Band Pass Gain | 20 x .01 | 200 x 100 | 6 kHz | 1 Volt at Output |
| | Measure input voltage. Limits are 0.9 to 1.1 volts. Switch LCO to x10 and x100. Each time adjust output to 1 volt. Input voltage limits are 0.9 to 1.1 volt. | | | |
| 2. Attenuation Slope-HCO | 20 x .01 | 200 x 100 | 6 kHz | 1 volt at input |
| | a) Switch osc to 40 kHz, output should be 50 to 80 millivolts<br>b) Switch HCO to 200 x10, osc to 4 kHz<br>c) Switch HCO to 200 x1, osc to 400 Hz<br>d) Switch HCO to 200 x .1, osc to 40 Hz<br>e) Switch HCO to 200 x .01 osc to 4 Hz<br>In each case, a) through e), output voltages should be between 50 and 80 millivolts. | | | |
| 3. Attenuation Slope LCO | 20 x 100 | 200 x 100 | 6 kHz | 1 volt at output |
| | a) Switch osc to 1 kHz. Output should be 50 to 80 millivolts.<br>b) Switch LCO to 20 x10, set output to 1 volt.<br>c) Switch osc to 100 Hz. Output should be 50 to 80 millivolts.<br>d) Switch LCO to 20 x 1. Set output to 1 volt.<br>e) Switch osc to 10 Hz. Output should be 50 to 80 millivolts.<br>f) Switch LCO to 20 x.1.<br>g) Switch osc to 1 Hz. Output should be 50 to 80 millivolts.<br>h) Switch LCO to 20 x.01.<br>i) Switch osc to 0.1 Hz. Output should be 50 to 80 millivolts. | | | |
| 4. 20 dB Gain Operation | 20 x 100 | 200 x 100 | 6 kHz | 0.1 volt at output |
| | With GAIN switch in 0 dB position set osc amplitude for 0.1V at output. Switch GAIN to 20dB position. Output should read 1.0 ± .1 volt. | | | |
| 5. x.01 Multiplier Calibration | 20 x .01 | 200 x .01 | .6 Hz | 1 volt at output |
| | Using the oscilloscope for making amplitude measurements, switch osc from .6 Hz to 0.2 Hz and then to 2 Hz. Output should read 0.63 to 0.77 volt, at both frequencies. | | | |

Table 3-1 (Contd.) Acceptance Checkout Procedure

| Test | Low Cutoff | High Cutoff | Input Freq. | Set Amplitude |
|---|---|---|---|---|
| 6. x.1 Multipler Calibration | 20 x .1 | 200 x .1 | 6 Hz | 1 volt at output |
| | Using the oscilloscope for making amplitude measurements, switch osc from 6 Hz to 2 Hz and then to 20 Hz. Output should read .63 to .77 volt at both frequencies. | | | |
| 7. x1 Multiplier Calibration | 20 x 1 | 200 x 1 | 60 Hz | 1 volt at output |
| | Switch osc to 20 Hz and then to 200 Hz. Output should read .63 to .77 volt at both frequencies. | | | |
| 8. x10 Multiplier Calibration | 20 x 10 | 200 x 10 | 600 Hz | 1 volt at output |
| | Switch osc to 200 Hz and then to 2 kHz. Output should read .63 to .77 volt at both frequencies. | | | |
| 9. x100 Multiplier Calibration | 20 x 100 | 200 x 100 | 6 kHz | 1 volt at output |
| | Switch osc to 2 kHz and then to 20 kHz. Output should read .63 to .77 volt at both frequencies. | | | |
| 10. Maximum Output Voltage | 200 x .01 | 200 x 100 | 100 Hz | 1 volt at input |
| | Connect oscilloscope to output. Increase osc signal voltage until clipping is observed. Output voltage should reach 5 vrms before clipping occurs. | | | |
| 11. Maximum Output Current | 200 x .01 | 200 x 100 | 100 Hz | |
| | Connect oscilloscope to output. Connect 47-ohm load across output. Increase input voltage until clipping occurs at output. Output voltage should be greater than 50 millivolts before clipping occurs. | | | |
| 12. Maximum Attenuation | 200 x 100 | 200 x 100 | 1.5 kHz | 5 volts at input |
| | Connect acvm to output. Output should read less than 500 microvolts. | | | |
| 13. Hum and Noise | 20 x 100 | 20 x 100 | No Input | -- |
| | Place covers on unit and shield inputs. Operate dials and switches to find maximum hum and noise. Limit is 200 microvolts. | | | |
| 14. Battery Operation (If batteries are installed) | 20 x .01 | 200 x 100 | 6 kHz | 1 volt at output |
| | With POWER switch in BATT OPR position, and line cord disconnected from line, repeat step 1. Filter should meet requirements of step 1. | | | |
| 15. Battery Charge (If batteries are not installed) | --- | --- | --- | --- |
| | Remove top cover. With POWER switch in BAT CHG LINE OPR position, measure voltage at point 24. Limits + 12 to + 14 vdc. Measure voltage at point 28. Limits: -12 to -14 vdc. | | | |
| 16. Battery Charge (If batteries are installed) | --- | --- | --- | --- |
| | Remove top cover. With POWER switch BAT CHG LINE OPR position, measure DC voltage across each of the 2 Watt 100 ohm resistors (R501 and R502) on the rear of the PC board. | | | |

# SECTION 4
# CIRCUIT DESCRIPTION

## 4.1 INTRODUCTION

The circuit arrangement of the Model 3700 is shown in the block diagram, Figure 4-1. The filter consists of an input amplifier, for isolation; a four-pole high-pass section (low cutoff frequency); a four-pole low-pass section (high cutoff frequency); an output amplifier and the power supply. Each section utilizes four RC networks and two feedback amplifier loops. An attenuator at the input provides for selection of 0 dB or 20 dB gain. The response switch is used to select a Butterworth (MAX FLAT) or RC (LOW Q) response. To keep current drain to a minimum, all stages are high-impedance FET-input amplifiers. The various circuits are described below. The schematic diagram is at the end of this book.

## 4.2 INPUT AMPLIFIER

The input signal is capacitor coupled to the input amplifier consisting of Q101 and Q102. The input signal amplitude can be attenuated by means of GAIN switch S801 and a network consisting of R103, R104, R105, and C101 through C106. When the switch is in the 20 dB position, R104 shunts R103, while in the 0 dB position, R103 remains in series with the signal, and R104 goes to ground, providing an attenuation of 10:1. To compensate for gain loss due to stray capacitance, R701, P102 and R112 are switched in on the two highest bands.

## 4.3 LOW CUTOFF (HIGH PASS SECTION)

The Low Cutoff section consists of two "quadratics", so called because of their second order ( quadratic ) transfer functions. The tuning networks of the first quadratic contain two capacitors -- values selected by the bandswitch - and two resistors, ganged potentiometers P601 and P602, adjusted by the tuning dial. Each potentiometer is trimmed with series and parallel resistors (R601 to R609) to insure proper calibration. FET input amplifier Q201-202 isolates the first quadratic from the second and drives P601, the midpoint of the tuning network through the voltage divider R204-205, P201.

This network, as enclosed by the broken line in Figure 4-1, labeled "A", and its Low Pass counterpart "B" are the basic building blocks of all Krohn-Hite filters to date.

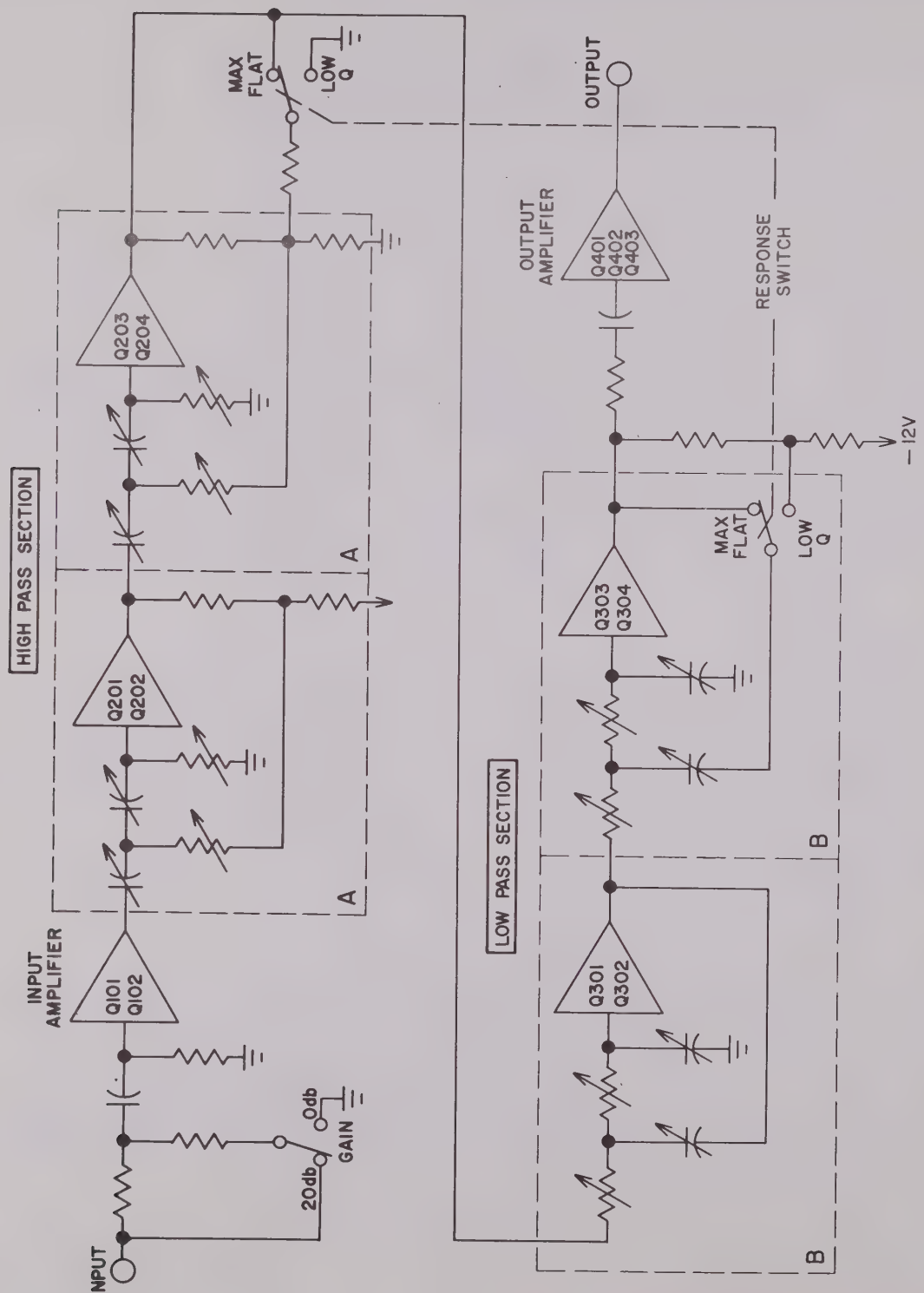



Figure 4-1. Block Diagram

The transfer functions of these networks are

$$\frac{E_2}{E_1} = \frac{s^2}{s^2 + 2as + 1} \qquad \text{for the high pass}$$

and

$$\frac{E_2}{E_1} = \frac{1}{s^2 + 2as + 1} \qquad \text{for the low pass}$$

where $s = j\frac{\omega}{\omega_o}$

$\omega = 2\pi f$ angular frequency

$\omega_o = 2\pi f_o$ cutoff angular frequency

$j = \sqrt{-1}$

a = "peaking factor"

determines the shape of the response curve. Figure 4-2 shows the response of the two quadratics of the high-pass section of the Model 3700, and of the complete section.

The second quadratic of the HP section also has two switch-selected capacitors and two dial-adjusted resistors (Band switch and tuning dial are, of course common to both HP quadratics). Some additional features: To reduce the capacitance loading of shielded input lead "8", the shield "9" is driven from the source of input FET Q203. Residual capacitance is neutralized by driving the gate of Q203, through a small capacitor (C202) from the output of the loop.

The RESPONSE switch S901A changes the feedback of the second quadratic and modifies the response as described in section 2.5.2 - 2.5.3.

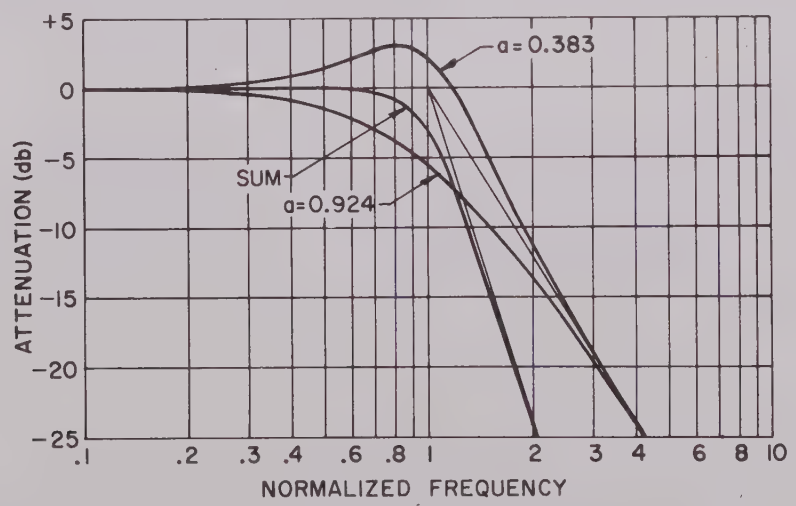



Figure 4-2. Response of Low Cutoff Quadratic

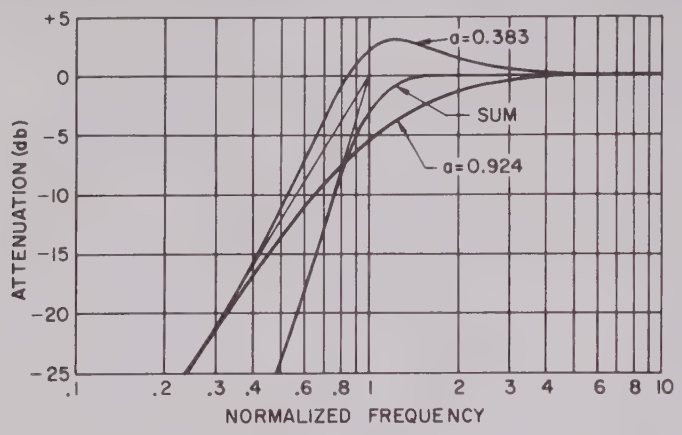



Figure 4-3. Response of High Cutoff Quadratic

### 4.4 HIGH CUTOFF (LOW PASS SECTION)

The transfer functions of the low pass quadratics, Figure 4-3, are exact mirror images of the high pass ones in Figure 4-2.

The quadratics themselves also resemble the high pass networks but with the R's and C's interchanged. (See "B" in Figure 4-1). All four capacitors again are switched by the multiplier switch, and the resistors adjusted by the tuning dial.

The second quadratic again incorporates a RESPONSE switch, S901B. This switch reduces the feedback in its LOW Q position, thus modifying the response of the section as shown in Figure 2-5 and described in 2.5.2-2.5.3. The other half of this switch S901A does the same thing in the high-pass section.

### 4.5 OUTPUT AMPLIFIER

Output of the high cutoff section is capacitor-coupled (C402) to the input gate of the output amplifier. R407-C403 make up a low-pass filter, to reduce output noise by limiting bandwidth.

The output amplifier has unity feedback - from the collector of Q402 to the source of the input FET - Q401. Q403 is just an emitter follower, holding the emitter of Q402. Diodes CR401 and CR402 temperature-compensate for the base-emitter diodes of Q402 and 403. Q404 is used as a Zener diode, stabilizing the bias supply of Q401, especially for battery operation, when ±12V will change as batteries discharge. Coarse (P401) and fine (P901) output level adjustment potentiometers are fed by this Zener voltage.

### 4.6 POWER SUPPLY

The POWER switch has four positions. Position 1 is OFF. In position 2, the switch connects the primary of transformer T501 to the power line for line operation of the filter. In position 3, the switch also connects the power transformer to half

wave rectifiers CR505 and CR506 for charging batteries. In position 4, the switch disconnects the transformer from the line and connects the batteries to the -12 volt and + 12 volt lines without regulation or filtering.

The output of the bridge rectifier R501 through 504 is smoothed by capacitors C501 and C504 and applied to the emitters of series regulating transistors Q504 and Q507.

Each series regulator is driven by a 2 stage amplifier -- Q502, 503 for the positive supply, Q505, 506 for the negative.

The reference voltage is supplied by Q501 -- used as a Zener in the negative supply, "sitting" on the -12 Volt bus. Through a resistor network -- R503, 504, 505 and 509 -- the positive end of this voltage gets to the base of Q505. Any change in the -12 Volt level is applied (somewhat attenuated) to this base, amplified in Q505 and then in Q506 and supplied to the base of Q507 in the proper direction to correct the original deviation.

The + 12 Volt regulated supply is slaved to the -12 Volt supply. Voltage divider R506, 508 (trimmed by R507) between the + 12 Volt and -12 Volt holds the base of Q502 centered between these two levels. Emitter of Q502 is held at minus 0.6 Volt by the forward drop of diode CR512 -- so its base will be at ground level. Change in either + 12 Volt or -12 Volt level will move the base of Q502; this change will be amplified by Q502 and Q503 and applied to the base of Q504 to cause a change in the + 12 Volt supply to restore the base of Q502 to the ground level -- thus making the +12 Volt supply equal in magnitude to the -12 Volt supply.

Resistors R514 and R522 in parallel with the series transistors limit their power dissipation, especially under overload or short circuit conditions. Diodes CR508 to CR511 and 18 - ohm resistors R513 and R522 also take part in this action: increased current in the 18 -ohm resistors causes increased voltage drop. When this voltage, added to the base-to-emitter voltage of the series transitor approaches about 1 volt, the two diodes on the series transistor base start conducting and limit this voltage -- turning off the series transistor. Under large overload or short circuit conditions the series transistors will be turned off completely and the power supply current will be limited by R514 and R520.

# SECTION 5
# MAINTENANCE

## 5.1 INTRODUCTION

If the Model 3700 is not functioning properly and requires service, follow this procedure to locate the source of trouble. To obtain access to the interior of the filter, remove the screws centered at the rear of each cover; sliding off the side covers will unlock the top and bottom covers.

The general layout of major components, test points, screwdriver controls and adjustments are shown in Figure 5-1. A detailed component layout for the printed circuit card is included with the schematic diagram at the end of this book. Various check points and voltages are shown on the schematic diagram and are also marked on the printed circuit card.

First make a visual inspection; check the unit for broken wires, burnt or loose components, or similar conditions which could cause trouble. Any troubleshooting of the Filter will be greatly simplified if you understand the operation of the circuit. Before attempting detailed troubleshooting refer to Circuit Description, Section 4.

## 5.2 POWER SUPPLY

If the filter does not seem to be working properly, check the power supply first. Any malfunction of the power supply will generally cause a large error in positive or negative 12 volt output. Small errors in level may be corrected by trimming R504 and R507 (procedure for this trim is given in Section 6).

Input filter capacitors (C501, C504) may cause excessive ripple if defective. If regulation is poor, check the regulating action of the negative supply first, since the negative supply contains the reference for both.

## 5.3 SIGNAL TRACING ANALYSIS

If the power supplies appear to be correct but the Model 3700 is not working, the following signal tracing analysis should help locate the area of malfunction: Set the controls as called for in Table 5-1. Connect a 200 Hz 5-volt rms sine wave signal to the input terminals. If the test signal does not appear correctly at the output, the area of the malfunction may be localized by determining where in the Filter the signal first deviates from the normal.

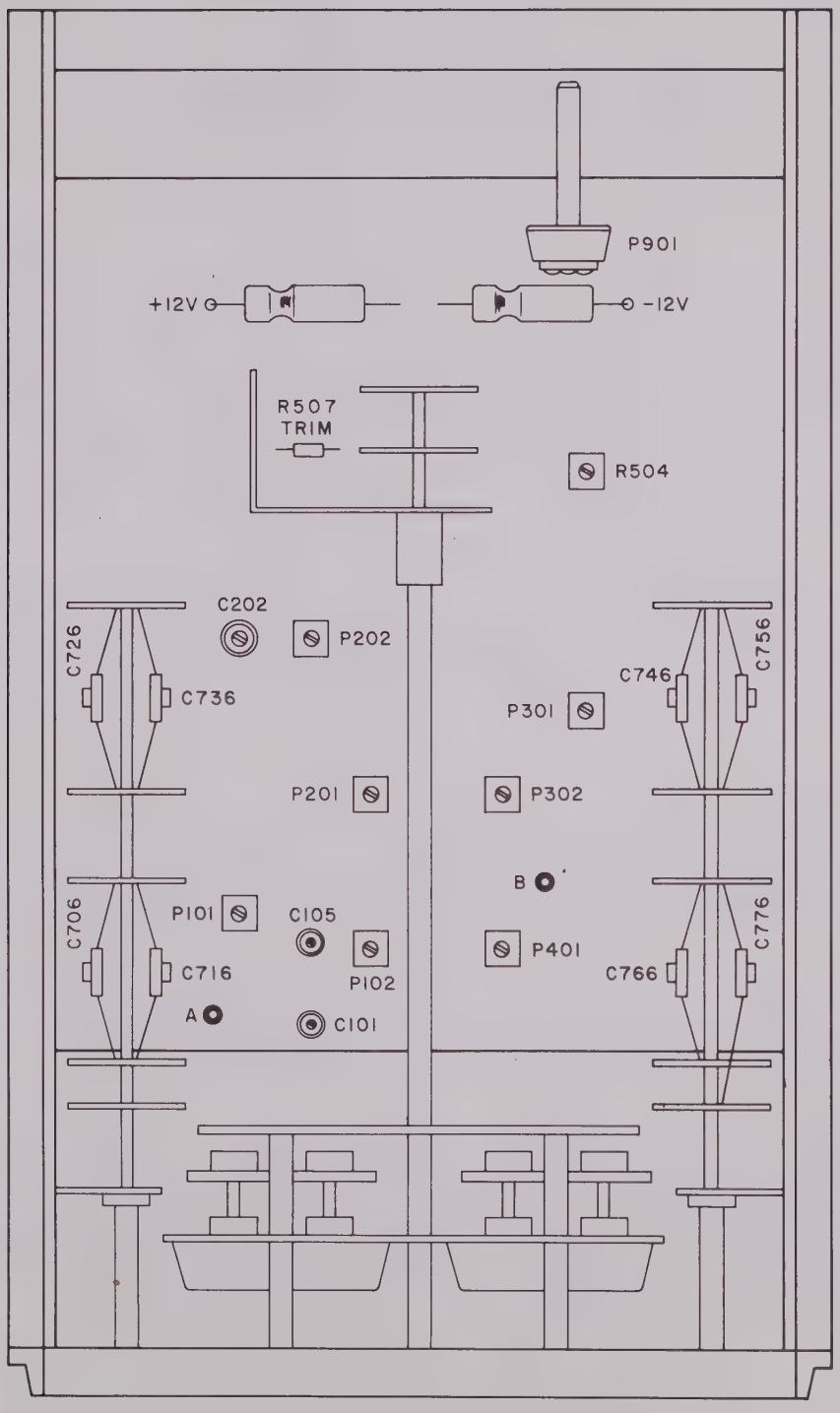



Figure 5-1. Location of Trims and Adjustable Components

| Test Point | Voltage Rms |
|---|---|
| 4 | 1.3 |
| 5 | 0.65 |
| 7 | 0.70 |
| 8 | 0.29 |
| 13 | 0.60 |
| 15 | 0.30 |
| 16 | 0.35 |
| 17 | 0.16 |
| 19 | 0.30 |
| 22 | 0.30 |

Control settings:

Input - 200 Hz, 5V rms
Response - Low Q
Gain - 0 dB
High and Low cutoff 200 x 1

Table 5-1. Test Point vs Signal Voltage

Table 5-1 shows various test points with their correct signal levels. If a test point is found whose signal level differs appreciably from the correct value, the circuitry immediately preceding that test point should be carefully checked.

### 5.4 TUNING CIRCUITS

If signal tracing shows one of the tuning circuits to be faulty, it should be determined if the trouble is in the resistive or capacitive elements. If the trouble is in a capacitive element the malfunction will appear only in one switch position. If there is a problem in a resistive element, the trouble will show up on all multiplier bands.

The values of capacitance used on the highest band are selected to compensate for stray capacitance and are therefore not completely in decade ratios of those used on the lower bands.

Each of the variable resistance elements consists of four potentiometers ganged together with a gear assembly. Each potentiometer has series and shunt trims to insure proper tracking. The trims and the angular orientation of the potentiometers are carefully adjusted at the factory. If it becomes necessary to change one of these potentiometers in the field, it should be replaced only with a unit supplied by the factory complete with proper trims. The angular orientation should then be carefully adjusted following the procedure supplied with the parts.

# SECTION 6
# CALIBRATION AND ADJUSTMENT

## 6.1 INTRODUCTION

Before making any adjustments, follow the performance test procedure in Section 3 to determine if adjustments are necessary. The following procedure is provided for the adjustment and calibration of the filter in the field, and adherence to this procedure should restore the filter to its original specifications. If any difficulties are encountered, please refer to Maintenance, Section 5. If any question arises which is not covered by this procedure, please contact our factory service department. The locations of major components are shown in Figure 5-1. The test points are marked on the PC board.

Access to the interior of the Model 3700 is gained by removing the screw centered at the rear of each cover; sliding off the side covers will unlock the top and bottom covers.

## 6.2 TEST EQUIPMENT REQUIRED

The following test equipment is required to perform these tests.

**6.2.1** Digital Voltmeter (DVM), capable of measurements from 1 millivolt to 20 volts, Fluke Model 8000A or equal.

**6.2.2** A-C voltmeter capable of measurements from 100 microvolts to 10 volts rms, Ballantine Model 314A or equal.

**6.2.3** Oscilloscope DC to 5 MHz, 10 mv/cm sensitivity.

**6.2.4** Oscillator; 0.01 Hz to 1 MHz; with frequency accuracy better than 3%; distortion, hum and noise less than 0.05%; frequency response ±.05 dB (Krohn-Hite Model 4100A or equal).

## 6.3 POWER SUPPLY

### 6.3.1 B+ and B- Regulator

Connect the d-c voltmeter between ground and + 12 volts (right end of R514). Limits are + 11.8 to + 12.2 volts. Connect the dc voltmeter between ground and -12 volts (left end of R520). Limits are -11.8 to -12.2 volts. If either supply is out of limits, trim as follows: a) Trim R507 to bring both positive and negative voltages within 0.2 volt of same absolute value. Trimming of R507 will mostly affect + 12V, but -12V will also change -- about one-fourth as much. Therefore, both voltages should be checked during the trimming process. If any voltage rises above + 14 volts -- place a preliminary trim on R504 to bring it down, then continue.

## 6.4 CALIBRATION PROCEDURE

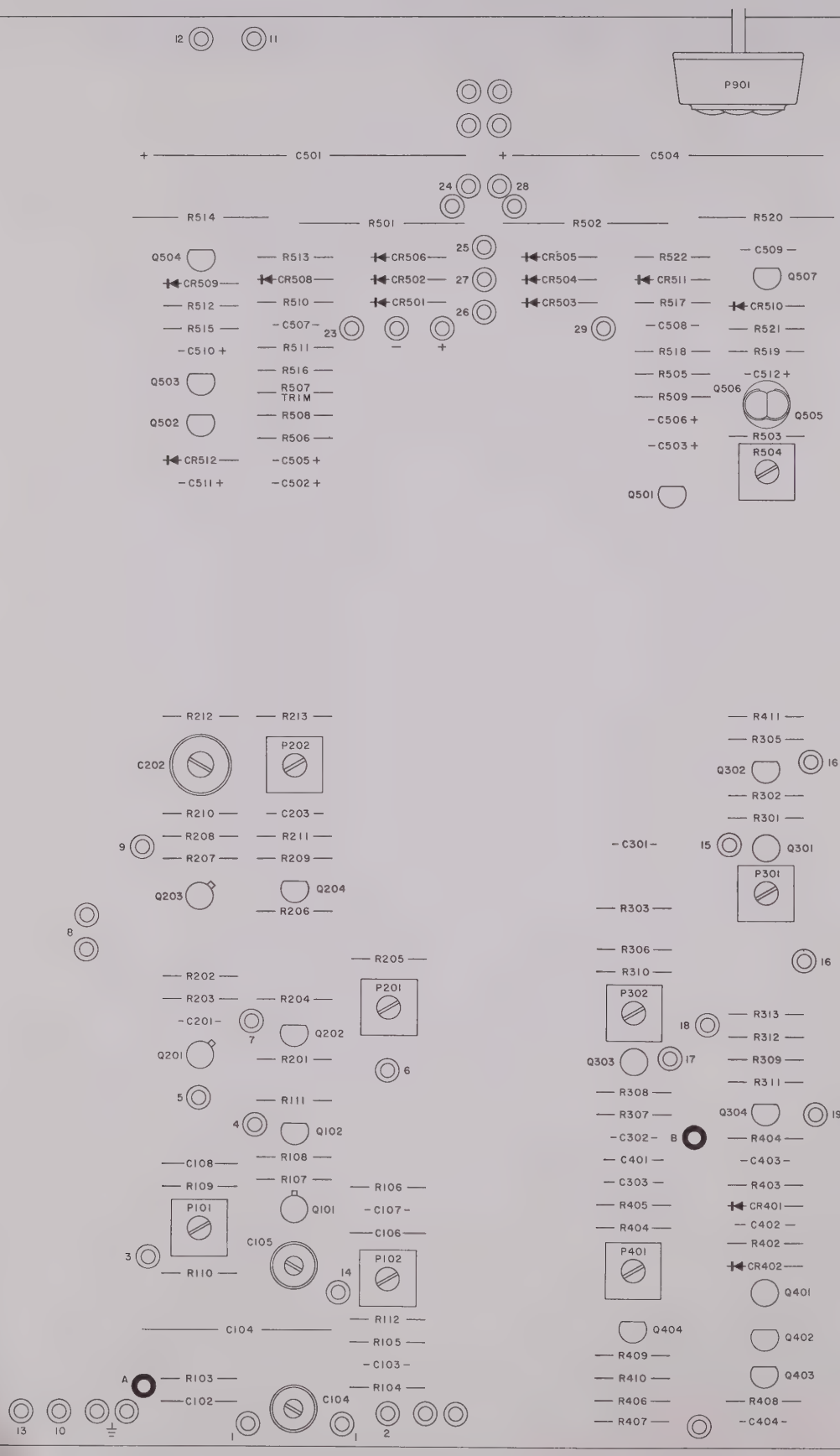
The calibration procedure is given in Table 6-1. In the table, the initial setup is given in tabular form at the beginning of each test, and then follows a sequence of steps. It is important that the sequence be followed in order. Nominal oscillator output voltage at the beginning of all tests is 1 volt rms. Amplitude is then adjusted at the test point given. Unless otherwise specified, voltages are rms, the GAIN switch is in the 0 dB position and the RESPONSE switch is in the MAX FLAT position.

Table 6-1. Calibration Procedure

| Test | Low Cutoff | High Cutoff | Input Freq. | Set Amplitude |
|---|---|---|---|---|
| 1. Output DC Level | ----- | --- | No Signal | ------ |
| | Short input. Connect dc voltmeter to output. Adjust P901 to the center of its range. Adjust P401 for 0vdc ±10 millivolts. | | | |
| 2. Input Broadbanding | ----- | --- | 50 Hz | 1 volt at TP4 |
| | Switch osc to 5 kHz. Adjust C101 for 1 volt at TP4. | | | |
| 3. 20 dB gain | ----- | --- | 50 Hz | 0.1 volt at TP4 |
| | Place GAIN switch in 20 dB position. TP4 voltage should be 1±0.1 volt. Switch osc to 5 kHz. Adjust C105 for same voltage at TP4. Return GAIN to 0 dB position. Repeat Step 2 if C105 has required adjustment. | | | |
| 4. LCO Dial Set | 60 x 1 | 200 x 100 | 200 Hz | 1 volt at output |
| | Switch osc to 30 Hz. Adjust LCO dial for 63 millivolts at output. Dial should read 60. If off, loosen dial set-screws and set to 60. Tighten. | | | |
| 5. LCO x1 Response | 60 x 1 | 200 x 100 | 600 Hz | 1 volt at TP7 |
| | Switch osc to 60 Hz. Adjust P201 for .54 volt at TP7. Connect the acvm to TP13. Switch osc to 600 Hz. Adjust osc voltage for 1 volt at TP13. Switch osc to 60 Hz. Adjust P202 for 0.7 volt at TP13. | | | |

Table 6-1 (Contd.) Calibration Procedure

| Test | Low Cutoff | High Cutoff | Input Freq. | Set Amplitude |
|---|---|---|---|---|
| 6. Neutralization | 20 x 100 | 200 x 100 | 20 kHz | ----- |
| | Short C725 and C735 with clipleads. Adjust osc for 1 volt at TP13. Remove cliplead from C735. Adjust C202 for 1.05 volt at TP13. Remove cliplead from C725. | | | |
| 7. LCO x 100 Adjust | 20 x 100 | 200 x 100 | 20 kHz | ----- |
| | 7a) Short input resistor R101 with a cliplead. Place top cover on filter. Connect acvm to TP7, and adjust osc voltage for 0.1 volt at TP7. Switch osc to 2 kHz. Adjust C706 for 55 millivolts at TP7. Switch osc to 1 kHz. Adjust C716 for 23 millivolts at TP7. Repeat adjustments at 20 kHz, 2 kHz, and 1 kHz in this order until all are correct.<br>7b) Connect the acvm to TP13. Set osc to 20 kHz, 1 volt at TP13. Switch osc to 2 kHz. Adjust C726 for .68 volt at TP13. Switch osc to 3 kHz. Adjust C736 for .98 volt at TP13. Repeat steps at 20 kHz, 2 kHz and 3 kHz in this order until all are correct. Remove short across R101. | | | |
| 8. HCO Dial Set | 20 x .01 | 60 x 1 | 20 Hz | 1 volt at output |
| | Switch osc to 120 Hz. Adjust dial for a reading of 63 millivolts at output. Dial should indicate 60. If it is off, loosen setscrews and set to 60. Tighten. | | | |
| 9. HCO x 1 Response | 20 x .01 | 60 x 1 | 20 Hz | 1 volt at TP16 |
| | 9a) Set TP16 to 1 volt at 20 Hz. Switch osc to 60 Hz. Adjust P301 for .58 volt at TP16. If P301 requires adjustment repeat 9a.<br>9b) Connect acvm to TP19. Switch osc to 20 Hz, amplitude 1 volt at TP19. Switch osc to 60 Hz. Adjust P302 for .7 volt at TP19. If P302 requires adjustment, repeat 9b. | | | |
| 10. HCO x 100 Adjust | 20 x .01 | 20 x 100 | 200 Hz | 1 volt at TP19 |
| | 10a) Set TP16 to 1 volt at 200 Hz. b) Switch osc to 4 kHz. Adjust C746 for 0.21V at TP16. c) Switch osc to 2 kHz. Adjust C756 for .54 volt at TP16. Repeat 10a, b, and c in this order until all are right. d) Connect the acvm to TP19. Switch osc to 200 Hz, amplitude 1 volt at TP19. 10e) Switch osc to 2 kHz. Adjust C776 for .70 volt at TP19. f) Switch osc to 4 kHz, adjust C766 for 63 millivolts at TP19. Repeat 10d, e, and f until all are right. | | | |
| 11. Unity Gain | 20 x 1 | 200 x 100 | 6 kHz | 1 volt at input |
| | Connect acvm to output. Adjust P101 for 1 volt at output. Switch LCO to 20 x 10. Voltage should be .98 to 1.02V at output. If off trim R701. Switch LCO to 20 x 100. Trim P102 for 1 volt at output. Check the dc level at TP4. If level is greater than ±6 volts, trim R112 and repeat step 11. | | | |


P901
C501
C504
R514
R501
R502
R520
Q504
CR509
R512
R515
C510+
Q503
Q502
CR512
C511+
R513
CR508
R510
C507-
R511
R516
R507 TRIM
R508
R506
C505+
C502+
CR506
CR502
CR501
CR505
CR504
CR503
R522
CR511
R517
C508-
R518
R505
R509
C506+
C503+
C509-
Q507
CR510
R521
R519
C512+
Q506
Q505
R503
R504
Q501
R212
R213
C202
P202
R210
C203-
R208
R211
R207
R209
Q203
Q204
R206
R205
R202
R203
C201-
R204
P201
Q201
Q202
R201
R111
Q102
C108
R108
R109
R107
R106
C107-
P101
Q101
C106
C105
P102
R110
R112
C104
R105
C103-
R104
R103
C102
C104
R411
R305
Q302
R302
R301
C301-
Q301
P301
R303
R306
R310
P302
R313
R312
Q303
R309
R311
R308
R307
Q304
C302-
R404
C401
C403-
C303
R403
R405
CR401
R404
C402
R402
P401
CR402
Q401
Q404
Q402
R409
R410
Q403
R406
R408
R407
C404-
A
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29

## CAPACITORS (CONT.)

| Symbol | Description | Mfr. | Part No. |
|---|---|---|---|
| C721 | 1mf +.5%,-3.5% 200V | TRW | KHC-15-105 |
| C722 | .1mf +1%-3% 200V | TRW | KHC-11-104 |
| C723 | .01mf +1%-3% 200V | TRW | KHC-11-103 |
| C724 | 1000pf 1% 500V | KGN | CM19C102F |
| C725 | 39pf 10% 500V | KGN | CM15C390K |
| C726 | 4-40pf TRIMMER | KH | 481004 |
| C731 | 1mf +.5%,-3.5% 200V | TRW | KHC-15-105 |
| C732 | .1mf +1%-3% 200V | TRW | KHC-11-104 |
| C733 | .01mf +1%-3% 200V | TRW | KHC-11-103 |
| C734 | 1000pf 1% 500V | KGN | CM19C102F |
| C735 | 91pf 10% 500V | KGN | CM15C910K |
| C736 | 4-40pf TRIMMER | KH | 481004 |
| C741 | 1mf +.5%,-3.5% 200V | TRW | KHC-15-105 |
| C742 | .1mf +1%-3% 200V | TRW | KHC-11-104 |
| C743 | .01mf +1%-3% 200V | TRW | KHC-11-103 |
| C744 | 1000pf 1% 500V | KGN | CM19C102F |
| C745 | 52pf 5% 500V | KGN | CM15C520J |
| C746 | 4-40pf TRIMMER | KH | 481004 |

| Symbol | Description | Mfr. | Part No. |
|---|---|---|---|
| C751 | 1mf +.5%,-3.5% 200V | TRW | KHC-15-105 |
| C752 | .1mf +1%-3% 200V | TRW | KHC-11-104 |
| C753 | .01mf +1%-3% 200V | TRW | KHC-11-103 |
| C754 | 1000pf 1% 500V | KGN | CM19C102F |
| C755 | 62pf 5% 500V | KGN | CM15C620J |
| C756 | 4-40pf TRIMMER | KH | 481004 |
| C761 | 1mf +.5%,-3.5% 200V | TRW | KHC-15-105 |
| C762 | .1mf +1%-3% 200V | TRW | KHC-11-104 |
| C763 | .01mf +1%-3% 200V | TRW | KHC-11-103 |
| C764 | 1050pf 1% 500V | KGN | CM19C105OF |
| C765 | 82pf 10% 500V | KGN | CM15C820K |
| C766 | 4-40pf TRIMMER | KH | 481004 |
| C771 | 1mf +.5%,-3.5% 200V | TRW | KHC-15-105 |
| C772 | .1mf +1%-3% 200V | TRW | KHC-11-104 |
| C773 | .01mf +1%-3% 200V | TRW | KHC-11-103 |
| C774 | 1000pf 1% 500V | KGN | CM19C102F |
| C775 | 33pf 5% 500V | KGN | CM15C330J |
| C776 | 4-40pf TRIMMER | KH | 481004 |

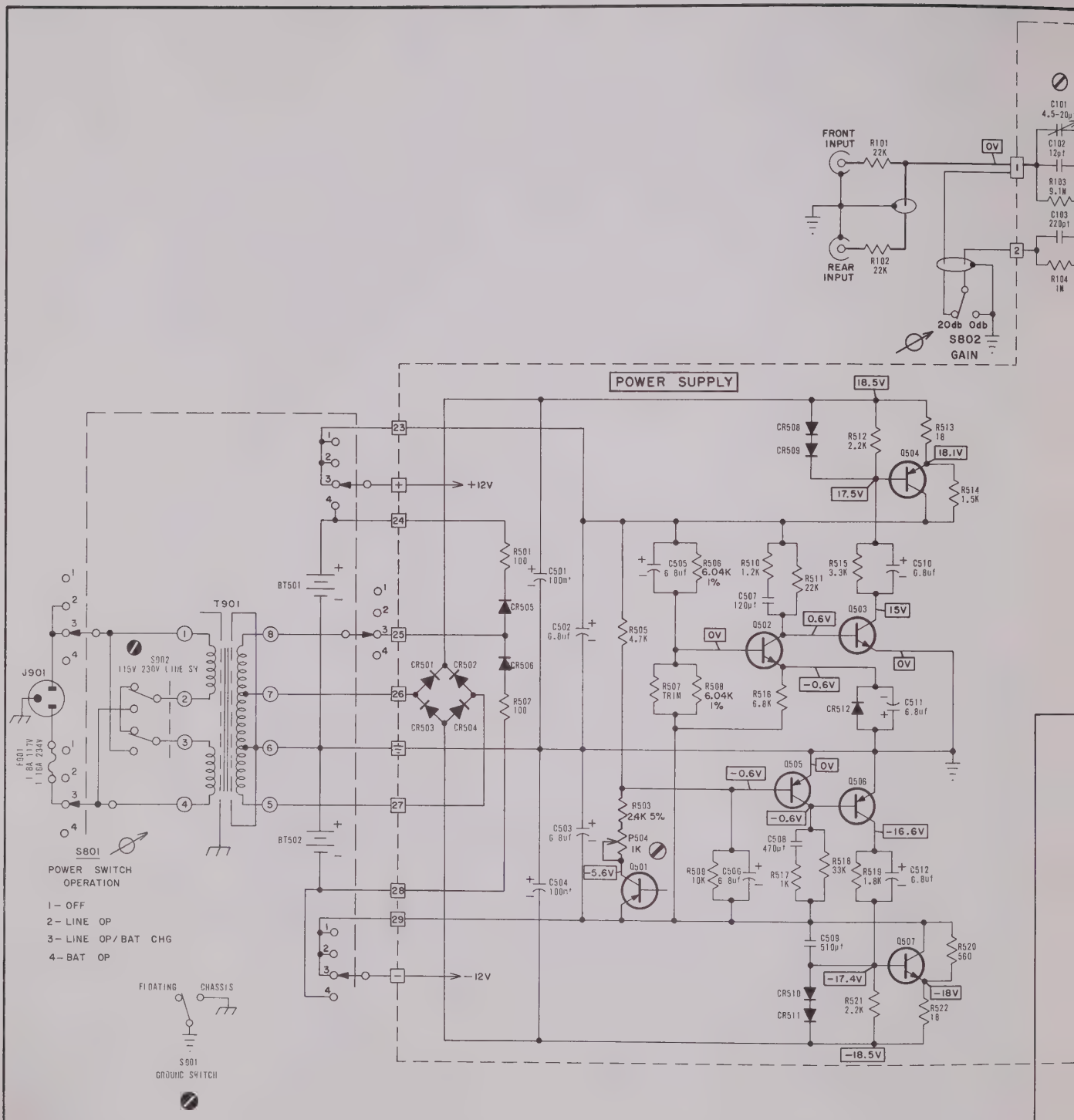
## TRANSISTORS, DIODES & MISC.

| Symbol | Description | Mfr. | Part No. |
|---|---|---|---|
| Q101 | 2N4302 | AME | 2N4302 |
| Q102 | MPS6518 | MOT | MPS6518 |
| Q201 | 2N4302 | AME | 2N4302 |
| Q202 | MPS6518 | MOT | MPS6518 |
| Q203 | 2N4302 | AME | 2N4302 |
| Q204 | MPS6518 | MOT | MPS6518 |
| Q301 | 2N4302 | AME | 2N4302 |
| Q302 | MPS6518 | MOT | MPS6518 |
| Q303 | 2N4302 | AME | 2N4302 |
| Q304 | MPS6518 | MOT | MPS6518 |
| Q401 | 2N4302 | AME | 2N4302 |
| Q402 | MPS6518 | MOT | MPS6518 |
| Q403 | MPS6515 | MOT | MPS6515 |
| Q404 | MPS3640 | MOT | MPS3640 |
| Q501 | MPS3640 | MOT | MPS3640 |
| Q502 | TIS97 | TI | TIS97 |
| Q503 | TIS97 | TI | TIS97 |
| Q504 | MPS6518 | MOT | MPS6518 |
| Q505 | MPS6518 | MOT | MPS6518 |
| Q506 | MPS6518 | MOT | MPS6518 |
| Q507 | TIS97 | TI | TIS97 |
| CR401 | 1N4149 | APD | 1N4149 |
| CR402 | 1N4149 | APD | 1N4149 |
| CR501 | 1N4002 | AS | 1N4002 |
| CR502 | 1N4002 | AS | 1N4002 |
| CR503 | 1N4002 | AS | 1N4002 |
| CR504 | 1N4002 | AS | 1N4002 |
| CR505 | 1N4002 | AS | 1N4002 |
| CR506 | 1N4002 | AS | 1N4002 |
| CR508 | 1N4149 | APD | 1N4149 |
| CR509 | 1N4149 | APD | 1N4149 |
| CR510 | 1N4149 | APD | 1N4149 |
| CR511 | 1N4149 | APD | 1N4149 |
| CR512 | 1N4149 | APD | 1N4949 |
| P101 | 1K POT | BKM | 72PM |
| P102 | 5K POT | BKM | 72PM |
| P201 | 1K POT | BKM | 72PM |
| P202 | 1K POT | BKM | 72PM |
| P301 | 5K POT | BKM | 72PM |
| P504 | 1K POT | BKM | 72PM |

| Symbol | Description | Mfr. | Part No. |
|---|---|---|---|
| P302 | 1K POT | BKM | 72PM |
| P401 | 25K POT | BKM | 72PM |
| P601 | 900K 10% 2W | AB | J95675 |
| P602 | 2.5M 10% 2W | AB | J95676 |
| P603 | 250K 10% 2W | AB | J95728 |
| P604 | 9.3M 10% 2W | AB | J95677 |
| P605 | 2.5M 10% 2W | AB | J95676 |
| P606 | 2.5M 10% 2W | AB | J95676 |
| P607 | 2.5M 10% 2W | AB | J95676 |
| P608 | 900K 10% 2W | AB | J95675 |
| P901 | 50K | KH | B3728 |
| BT501 | BATTERY, 12V, 500ma-hr | KH | Y5043 |
| BT502 | BATTERY, 12V, 500ma-hr | KH | Y5043 |
| F501 | FUSE, SLOW-BLOW, 115V | BUS | MDL-1/8A |
| | FUSE, SLOW-BLOW, 230V | BUS | MDL-1/16A |
| J501 | RECEPTACLE, AC POWER | SWC | EAC-301 |
| S501 | SWITCH, ROTARY, POWER | KH | B2832 |
| S502 | SWITCH, SLIDE, 115/230V | SWC | 46256LFR |
| S701 | SWITCH, ROTARY, LCO MULTIPLIER | KH | B2793/LCO |
| S702 | SWITCH, ROTARY, HCO MULTIPLIER | KH | B2793/HCO |
| S801 | SWITCH, TOGGLE, GAIN | CK | U11 |
| S802 | SWITCH, SLIDE, GROUND | CW | GF123 |
| S901 | SWITCH, SLIDE, MAX FLAT/ LOW Q | CW | G126 |
| T501 | TRANSFORMER, POWER | KH | B2796 |
| | LINECORD | PI | 13E37-1 |
| | RACK-MOUNTING KIT (NOT SHOWN) | KH | RK-38 |
| | BATTERY KIT (2 BATTERIES PLUS HARDWARE) | KH | BK-370 |

## MANUFACTURERS CODE

| | | | |
|---|---|---|---|
| AB | (01121) | Allen Bradley Co. | Milwaukee, WI |
| AME | (15815) | Amelco Inc. | Mt. View, CA |
| APD | (50273) | American Power Devices | Andover, MA |
| AS | ( ) | Atlantic Semiconductor | Woodland Hills, CA |
| AVX | (00656) | Aerovox, Corp. | New Bedford, MA |
| BKM | (30646) | Beckman Instr. Co. | Milwaukee, WI |
| BUS | (71400) | Bussman Mfg. Co. | St. Louis, MO |
| CK | (09353) | C & K Components | Watertown, MA |
| CW | (79727) | Continental Wirt Elec. | Philadelphia, PA |
| KGN | ( ) | Kahgan Electronics | Hempstead, NY |
| KH | (88865) | Krohn-Hite Corp. | Avon, MA |
| KID | (12126) | Kidco, Inc. | Medford, NJ |
| MOT | (04713) | Motorola Semiconductor | Phoenix, AZ |
| PI | ( ) | Phillips Industries | Chicago, IL |
| QC | ( ) | Quality Components, Inc. | St. Mary's, PA |
| SP | (56289) | Sprague Electric Co. | North Adams, MA |
| STT | ( ) | Stetner-Trush | Cazanovia, NY |
| SWC | (82389) | Switchcraft, Inc. | Chicago, IL |
| TI | (01295) | Texas Instruments, Inc. | Dallas, TX |
| TRW | (84411) | TRW Corp. | Ogallala, NE |




NOTES:

ALL RESISTORS IN OHMS UNLESS OTHERWISE SPECIFIED.

VOLTAGE READINGS TAKEN WITH UNIT OPERATED FROM 117V 60Hz LINE, SHORTED INPUT, BOTH DIALS AT 200 AND MULTIPLIERS AT x.01.

FET GATE TO SOURCE VOLTAGES CAN BE 1VOLT OR MORE DIFFERENT FROM VALUES GIVEN. THIS CAN RESULT IN A DIFFERENT VOLTAGE ON THE COLLECTOR OF THE NEXT STAGE ALSO.

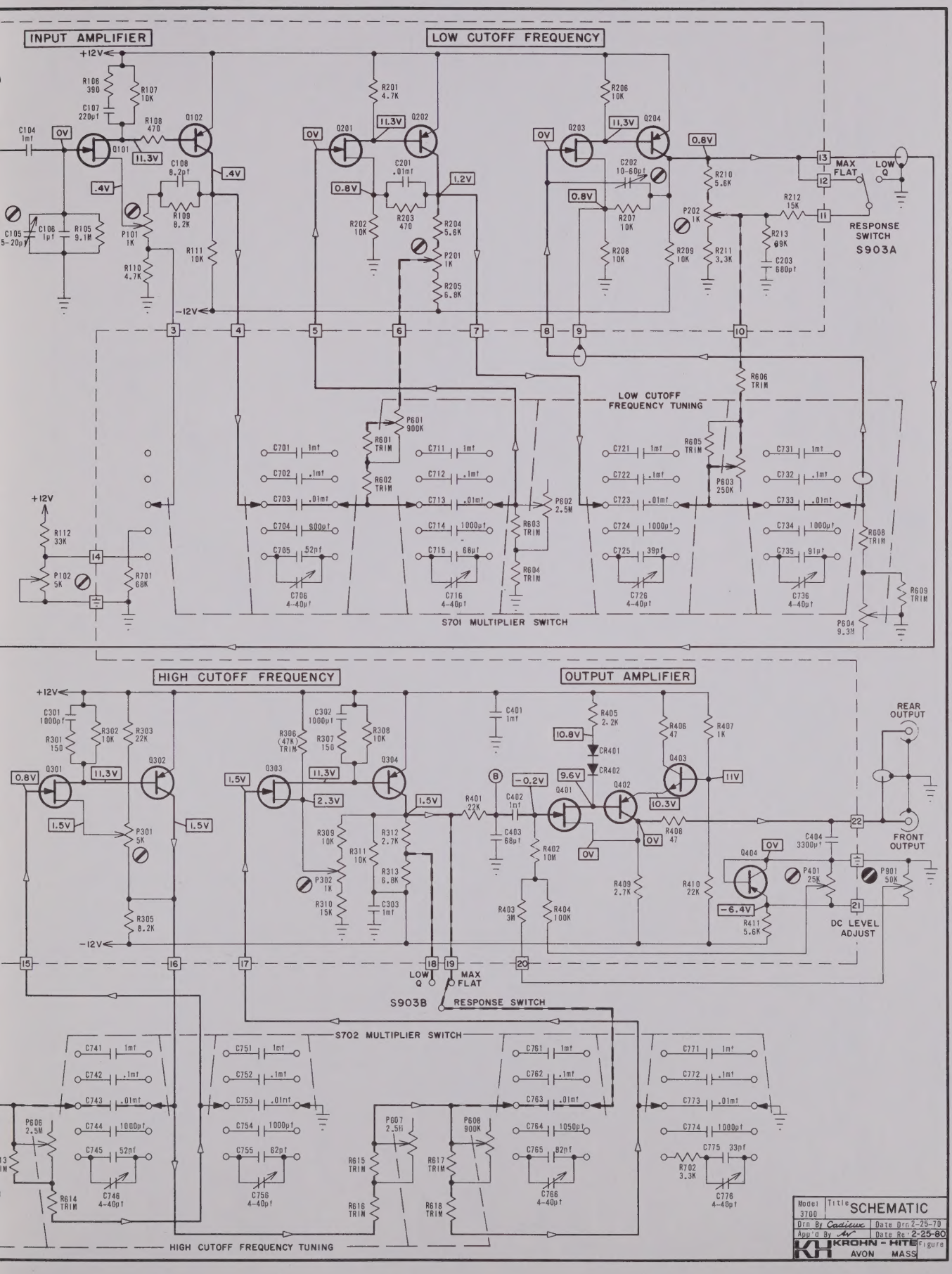
SIGNAL PATH

FEEDBACK PATH

FRONT PANEL CONTROL

REAR PANEL CONTROL

PCB CONTROL


INPUT AMPLIFIER
LOW CUTOFF FREQUENCY
+12V
-12V
R106 390
R107 10K
C107 220pf
R108 470
Q102
Q101
C104 1mf
0V
11.3V
.4V
C108 8.2pf
R109 8.2K
C106 1pf
C105 5-20pf
R105 9.1M
P101 1K
R110 4.7K
R111 10K
R201 4.7K
Q201
Q202
C201 .01mf
R202 10K
R203 470
R204 5.6K
P201 1K
R205 6.8K
1.2V
0.8V
R206 10K
Q203
Q204
C202 10-60pf
R207 10K
R208 10K
R209 10K
R210 5.6K
R211 3.3K
P202 1K
R212 15K
R213 Ø9K
C203 680pf
MAX FLAT
LOW Q
RESPONSE SWITCH
S903A
LOW CUTOFF FREQUENCY TUNING
R606 TRIM
P601 900K
R601 TRIM
R602 TRIM
R605 TRIM
P603 250K
P602 2.5M
R603 TRIM
R604 TRIM
R608 TRIM
R609 TRIM
P604 9.3M
C701 1mf
C702 .1mf
C703 .01mf
C704 900pf
C705 52pf
C706 4-40pf
C711 1mf
C712 .1mf
C713 .01mf
C714 1000pf
C715 68pf
C716 4-40pf
C721 1mf
C722 .1mf
C723 .01mf
C724 1000pf
C725 39pf
C726 4-40pf
C731 1mf
C732 .1mf
C733 .01mf
C734 1000pf
C735 91pf
C736 4-40pf
R112 33K
P102 5K
R701 68K
S701 MULTIPLIER SWITCH
HIGH CUTOFF FREQUENCY
OUTPUT AMPLIFIER
C301 1000pf
R301 150
R302 10K
R303 22K
Q301
Q302
P301 5K
R305 8.2K
C302 1000pf
R306 (47K) TRIM
R307 150
R308 10K
Q303
Q304
2.3V
1.5V
R309 10K
R310 15K
P302 1K
R311 10K
R312 2.7K
R313 6.8K
C303 1mf
C401 1mf
R401 22K
C402 1mf
C403 68pf
R402 10M
-0.2V
Q401
Q402
R405 2.2K
CR401
CR402
9.6V
10.8V
R406 47
R407 1K
Q403
11V
10.3V
R408 47
R409 2.7K
R410 22K
Q404
-6.4V
R411 5.6K
C404 3300pf
P401 25K
P901 50K
REAR OUTPUT
FRONT OUTPUT
DC LEVEL ADJUST
LOW Q
MAX FLAT
S903B
RESPONSE SWITCH
S702 MULTIPLIER SWITCH
C741 1mf
C742 .1mf
C743 .01mf
C744 1000pf
C745 52nf
C746 4-40pf
C751 1mf
C752 .1mf
C753 .01mf
C754 1000pf
C755 62pf
C756 4-40pf
C761 1mf
C762 .1mf
C763 .01mf
C764 1050pf
C765 82nf
C766 4-40pf
C771 1mf
C772 .1mf
C773 .01mf
C774 1000pf
C775 33pf
C776 4-40pf
P606 2.5M
R614 TRIM
P607 2.5M
R615 TRIM
R616 TRIM
P608 900K
R617 TRIM
R618 TRIM
R702 3.3K
HIGH CUTOFF FREQUENCY TUNING
Model 3700
Title SCHEMATIC
Drn By Cadieux
Date Drn 2-25-70
App'd By
Date Rev 2-25-80
KROHN-HITE
AVON MASS
Figure

## RESISTORS

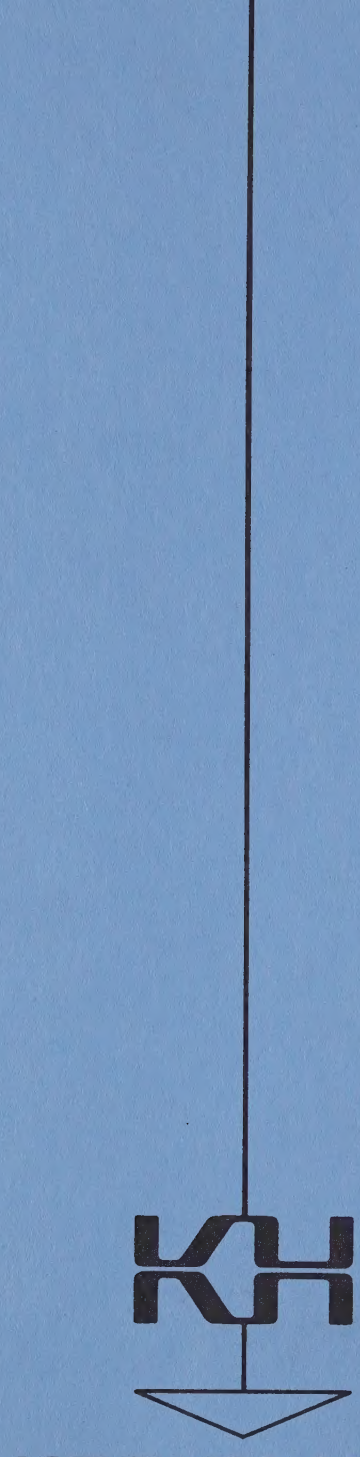
| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| R101 | 22K | 10% | 1/4W | AB | CB2231 |
| R102 | 22K | 10% | 1/4W | AB | CB2231 |
| R103 | 9.1M | 5% | 1/4W | AB | CB9155 |
| R104 | 1M | 5% | 1/4W | AB | CB1055 |
| R105 | 9.1M | 5% | 1/4W | AB | CB9155 |
| R106 | 390 | 10% | 1/4W | AB | CB3911 |
| R107 | 10K | 10% | 1/4W | AB | CB1031 |
| R108 | 470 | 20% | 1/4W | AB | CB4712 |
| R109 | 8.2K | 10% | 1/4W | AB | CB8221 |
| R110 | 4.7K | 10% | 1/4W | AB | CB4721 |
| R111 | 10K | 10% | 1/4W | AB | CB1031 |
| R112 | 33K | 10% | 1/4W | AB | CB3331 |
| R201 | 4.7K | 10% | 1/4W | AB | CB4721 |
| R202 | 10K | 10% | 1/4W | AB | CB1031 |
| R203 | 470 | 10% | 1/4W | AB | CB4711 |
| R204 | 5.6K | 10% | 1/4W | AB | CB5621 |
| R205 | 6.8K | 10% | 1/4W | AB | CB6821 |
| R206 | 10K | 10% | 1/4W | AB | CB1031 |
| R207 | 10K | 10% | 1/4W | AB | CB1031 |
| R208 | 10K | 10% | 1/4W | AB | CB1031 |
| R209 | 10K | 10% | 1/4W | AB | CB1031 |
| R210 | 5.6K | 10% | 1/4W | AB | CB5621 |
| R211 | 3.3K | 10% | 1/4W | AB | CB3321 |
| R212 | 15K | 10% | 1/4W | AB | CB1531 |
| R213 | 39K | 10% | 1/4W | AB | CB3931 |
| R301 | 150 | 10% | 1/4W | AB | CB1511 |
| R302 | 10K | 10% | 1/4W | AB | CB1031 |
| R303 | 22K | 10% | 1/4W | AB | CB2231 |
| R305 | 8.2K | 10% | 1/4W | AB | CB8221 |
| R306 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R307 | 150 | 10% | 1/4W | AB | CB1511 |
| R308 | 10K | 10% | 1/4W | AB | CB1031 |
| R309 | 10K | 10% | 1/4W | AB | CB1031 |
| R310 | 15K | 10% | 1/4W | AB | CB1531 |
| R311 | 10K | 10% | 1/4W | AB | CB1031 |
| R312 | 2.7K | 10% | 1/4W | AB | CB2721 |
| R313 | 6.8K | 10% | 1/4W | AB | CB6821 |
| R401 | 22K | 10% | 1/4W | AB | CB2231 |
| R402 | 10M | 10% | 1/4W | AB | CB1061 |
| R403 | 3M | 5% | 1/4W | AB | CB3055 |
| R404 | 100K | 10% | 1/4W | AB | CB1041 |
| R405 | 2.2K | 10% | 1/4W | AB | CB2221 |
| R406 | 47 | 10% | 1/4W | AB | CB4701 |
| R407 | 1K | 10% | 1/4W | AB | CB1021 |
| R408 | 47 | 10% | 1/4W | AB | CB4701 |

| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| R409 | 2.7K | 10% | 1/4W | AB | CB2721 |
| R410 | 22K | 10% | 1/4W | AB | CB2231 |
| R411 | 5.6K | 10% | 1/4W | AB | CB5621 |
| R501 | 100 | 10% | 2W | AB | HB1011 |
| R502 | 100 | 10% | 2W | AB | HB1011 |
| R503 | 2.4K | 5% | 1/4W | AB | CB2425 |
| R505 | 4.7K | 10% | 1/4W | AB | CB4721 |
| R506 | 6.04K | 1% | 1/4W | KID | M3-6041-T1F |
| R507 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R508 | 6.04K | 1% | 1/4W | KID | M3-6041-T1F |
| R509 | 10K | 10% | 1/4W | AB | CB1031 |
| R510 | 1.2K | 10% | 1/4W | AB | CB1221 |
| R511 | 22K | 10% | 1/4W | AB | CB2231 |
| R512 | 2.2K | 10% | 1/4W | AB | CB2221 |
| R513 | 18 | 10% | 1/4W | AB | CB1801 |
| R514 | 1.5K | 10% | 1W | AB | GB1521 |
| R515 | 3.3K | 10% | 1/4W | AB | CB3321 |
| R516 | 6.8K | 10% | 1/4W | AB | CB6821 |
| R517 | 1K | 10% | 1/4W | AB | CB1021 |
| R518 | 33K | 10% | 1/4W | AB | CB3331 |
| R519 | 1.8K | 10% | 1/4W | AB | CB1821 |
| R520 | 560 | 10% | 1W | AB | GB5611 |
| R521 | 2.2K | 10% | 1/4W | AB | CB2221 |
| R522 | 18 | 10% | 1/4W | AB | CB1801 |
| R601 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R602 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R603 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R604 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R605 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R606 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R608 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R609 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R611 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R612 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R613 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R614 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R615 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R616 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R617 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R618 | TRIM | 10% | 1/4W | AB | TYPE CB |
| R701 | 68K | 10% | 1/4W | AB | CB6831 |
| R702 | 3.3K | 10% | 1/4W | AB | CB3321 |

## CAPACITORS

| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| C101 | 4.5-20pf | TRIMMER | | STT | 7S-TRIKO-02-4.5/20pf |
| C102 | 12pf | 10% | 500V | QC | TYPE QC |
| C103 | 220pf | 10% | 500V | KGN | DM15C221K |
| C104 | 1mf | 10% | 200V | TRW | X663F-11 |
| C105 | 4.5-20pf | TRIMMER | | STT | 7S-TRIKO-02-4.5/20pf |
| C106 | 1pf | 10% | 500V | QC | TYPE QC |
| C107 | 220pf | 10% | 500V | KGN | DM15C221K |
| C108 | 8.2pf | 10% | 500V | QC | TYPE QC |
| C201 | .01mf | 20% | 500V | SP | C023B501G103M |
| C202 | 10-60pf | TRIMMER | | STT | 10S-TRIKO-06-10/60pf |
| C301 | 1000pf | 20% | 1000V | SP | 5GA-D10 |
| C302 | 1000pf | 20% | 1000V | SP | 5GA-D10 |
| C303 | 1mf | 20% | 100V | AVX | 3421-100E-105M |
| C401 | 1mf | 20% | 100V | AVX | 3421-100E-105M |
| C402 | 1mf | 20% | 100V | AVX | 3421-100E-105M |
| C403 | 68pf | 5% | 500V | KGN | DM15C680J |
| C404 | 3300pf | 20% | 1000V | SP | 5GA-D33 |
| C501 | 100mf | | 50V | SP | TE-1309 |
| C502 | 6.8mf | 20% | 35V | SP | 196D685X0035KA1 |

| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| C503 | 6.8mf | 20% | 35V | SP | 196D685X0035KA1 |
| C504 | 100mf | | 50V | SP | TE-1309 |
| C505 | 6.8mf | 20% | 35V | SP | 196D685X0035KA1 |
| C506 | 6.8mf | 20% | 35V | SP | 196D685X0035KA1 |
| C507 | 120pf | 5% | 500V | KGN | DM15C121J |
| C508 | 470pf | 10% | 500V | KGN | DM19C471K |
| C509 | 510pf | 10% | 500V | KGN | DM19C511K |
| C510 | 6.8mf | 20% | 35V | SP | 196D685X0035KA1 |
| C511 | 6.8mf | 20% | 35V | SP | 196D685X0035KA1 |
| C512 | 6.8mf | 20% | 35V | SP | 196D685X0035KA1 |
| C701 | 1mf | +.5%,-3.5% | 200V | TRW | KHC-15-105 |
| C702 | .1mf | +1%-3% | 200V | TRW | KHC-11-104 |
| C703 | .01mf | +1%-3% | 200V | TRW | KHC-11-103 |
| C704 | 900pf | 1% | 500V | KGN | CM19C901F |
| C705 | 52pf | 5% | 500V | KGN | CM15C520J |
| C706 | 4-40pf | TRIMMER | | KH | 481004 |
| C711 | 1mf | +.5%,-3.5% | 200V | TRW | KHC-15-105 |
| C712 | .1mf | +1%-3% | 200V | TRW | KHC-11-104 |
| C713 | .01mf | +1%-3% | 200V | TRW | KHC-11-103 |
| C714 | 1000pf | 1% | 500V | KGN | CM19C102F |
| C715 | 68pf | 5% | 500V | KGN | CM15C680J |
| C716 | 4-40pf | TRIMMER | | KH | 481004 |



KROHN-HITE
CORPORATION

MP MASTER
MA20016